International Journal of Surgery Open 1 (2015) 22–27

Contents lists available at ScienceDirect

International Journal of Surgery Open

journal homepage: www.elsevier.com/locate/ijso

Research Paper

Conventional versus fast track anaesthesia in an unselected group of patients undergoing revisional bariatric surgery

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ARTICLE INFO

Article history:
Received 18 December 2015
Received in revised form 16 February 2016
Accepted 20 February 2016
Available online 2 March 2016

Keywords:
Revisional bariatric surgery
Fast track anaesthesia

ABSTRACT

Introduction: Fast track care has proven to be safe and effective in primary bariatric procedures. The number of more complex revisional procedures is expected to rise over the next years. The aim was to evaluate the potential benefits and safety of a fast-track protocol in an unselected group of patients undergoing Roux-en-Y Gastric Bypass (rRYGBP) as revision.

Method: For this retrospective study, all patients undergoing rRYGBP between January 2005 and December 2013 were included and categorized between conventional care (CC) and fast track care (FT). Patient characteristics, operative details and intra- and early postoperative complications < 30 days were analysed.

Results: A total of 407 patients were included for analysis. 303 patients (74.4%) received peri- and postoperative treatment according to the fast track protocol. Mean age of the study population was 44.0 ± 8.9 years; mean pre-primary procedure BMI was 45.7 ± 7.0 kg/m^2. A total of 54 (13.3%) postoperative complications were registered (CC 19.2% vs FT 11.2%; $p = 0.038$). Both operative time (CC 135.3 ± 42.6 minutes vs FT 79.3 ± 29.3 minutes; $p < 0.001$) as well as hospital stay (CC 5.1 ± 6.3 days vs FT 3.1 ± 5.3 days; $p < 0.001$) were significantly shorter in the FT group. A multivariate analysis on postoperative complications showed that fast track was not predictive for the occurrence of complications (OR = 0.853; 95% CI [0.403–1.804]; $p = 0.677$).

Conclusion: Fast track care appears to be safe and efficient for patients undergoing revisional Roux-en-Y gastric bypass, but postoperative outcome may be highly dependent on surgical experience.

1. Introduction

Over the last years, a high number of bariatric procedures have been performed worldwide [1]. Therefore, it is expected that the number of revisions will increase over the next years. High revision rates up to 50% are found after either adjustable gastric banding (AGB) or vertical banded gastroplasty (VBG). Reported revision rates after sleeve gastrectomy (SG) are lower, keeping in mind that proper long-term follow-up after SG is scarce [2–7]. A frequently performed revision for these failed restrictive bariatric procedures is conversion to Roux-en-Y gastric bypass (RYGBP) [5,6,8]. In the early days of bariatric surgery, revisions were questioned for their safety and additional benefit [9]. Nowadays, for a specific group of patients with either complications of the primary bariatric procedure or weight regain, revisional bariatric surgery can be beneficial. Currently, the morbidity rate after revisional RYGBP is found to be similar compared to primary RYGBP [10].

Due to the high demand of bariatric procedures, fast track care is becoming increasingly popular for bariatric surgery. It is known to increase the efficiency and thereby the productivity on a daily basis, without increasing the risk of postoperative complications [11,12].

Since revisional bariatric surgery has become a lot safer over the last years, the demand for revisional bariatric surgery is expected to increase and the implementation of fast-track protocols in bariatric surgery is growing worldwide, the question is raised whether a fast-track protocol would be safe to implement in revisional bariatric surgery.

Sources for research and/or publication: None.

Disclosures: M.R. van Wezenbeek has nothing to disclose. S. Pouwels has nothing to disclose. M.P. Buise has nothing to disclose. J.F. Smulders has nothing to disclose. S.W. Nienhuijs has nothing to disclose. G van Montfort has nothing to disclose.

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http://dx.doi.org/10.1016/j.ijso.2016.02.008

This study aimed to evaluate the potential benefits and safety of a fast-track protocol in an unselected group of patients undergoing conversion to RYGBP bypass after VBG, AGB or SG.

2. Methods

For this retrospective analysis, medical charts of all patients undergoing revisional bariatric surgery between January 2005 and December 2013 at the Obesity Centre of the Catharina Hospital Eindhoven, a national referral centre for revisional bariatric surgery were reviewed.

This study has been approved by the Institutional Review Board of the Catharina Hospital and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki. All patients undergoing revisional Roux-en-Y gastric bypass (rRYGBP) after either adjustable gastric banding (AGB), sleeve gastrectomy (SG) of vertical banded gastroplasty (VBG, either Mason or Mason-MacLean approach) were included. Other revisional procedures (such as conversion to sleeve gastrectomy) were excluded. This study was conducted according to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.

Before January 2011, all bariatric patients were treated according to the hospital's conventional care (CC) protocol. Since January 2011, all patients, including those submitted to revisional procedures, at the Catharina hospital undergo bariatric surgery according to the new centre-adjusted fast track care (FT) protocol.

2.1. Fast track versus conventional care anaesthesia

Table 1 gives an overview of the FT and CC protocol. Furthermore, the CC protocol from this hospital has been described in detail before [13]. The screening and preoperative work-up programme was identical for the FT and CC group.

Many differences are found between CC and FT. Premedication in the CC protocol consisted of acetaminophen 1000 mg and diazepam 5 mg. No premedication was included in the FT protocol. In both groups, patients received thrombosis prophylaxis by 5000 units of Fraxiparin® (low-molecular weight heparin (LMWH)) and compression stockings. In both protocols, patients received standard haemodynamic monitoring (electrocardiography, pulsoximetry and non-invasive blood pressure measurement). In both groups, bispectral index monitoring and neuromuscular monitoring were routinely used to diminish the chance of awareness in the totally paralysed patient and to antagonize the muscle relaxant properly. Medication used for induction of the anaesthesia and for perioperative anaesthetic maintenance and postoperative analgesia are shown in Table 1.

At the end of the procedure, after antagonizing muscle relaxation with sugammadex, patients from the CC group were transferred from the operating room (OR) table to a normal ward bed by the OR personnel. In the FT protocol, desflurane and remifentanil were discontinued upon notification from the surgeon so the patients could be extubated immediately after the procedure and thus were able to move from the operation table to their bed themselves.

Following to the CC protocol, all male patients with a Body Mass Index (BMI) over 45 kg/m^2 and all female patients with a BMI over 50 kg/m^2 were transferred to the intensive care unit (ICU) for respiratory monitoring due to a higher risk developing atelectasis, respiratory dysfunction and complications in combination with the postoperative use of morphine. In the FT group, all patients were admitted to the recovery and transferred to the short-stay surgical ward after 1–2 hours. Furthermore, in the FT group, revisional procedures were normally performed during regular bariatric programmes between primary bariatric procedures, whereas in the CC group, revisional patients were planned on a separate operating programme.

2.2. Surgical procedure

The technique of the rRYGBP differed between the different primary procedures. The main difference is found in the

Table 1
Anaesthesia protocols.

Conventional care	Fast track care
Premedication	Premedication
Acetaminophen 1000 mg	None
Diazepam 5 mg	
Thrombosis prophylaxis	Thrombosis prophylaxis
Low molecular weight heparins (5000 IU)	Low molecular weight heparins (5000 IU)
Compression stockings	Compression stockings
Induction	Induction
Sufentanil 0.2–0.7 μg/kg	Piritramide 0.2–0.3 mg/kg
Propofol 2 mg/kg	Propofol 2 mg/kg
Rocuronium 0.6 mg/kg	Suxamethonium 1.0–1.5 μg/kg/hr
	Granisetron 3 mg
	Dexamethasone 8 mg
Maintenance	Maintenance
Remifentanil 5–15 μg/kg/hr	Remifentanil 5–15 μg/kg/hr
Sevoflurane or propofol 2–10 mg/kg/hr	Desflurane (6.0% vol.)
Rocuronium 0.4 mg/kg/hr	Bispectral index monitoring
Bispectral index monitoring	
Postoperative analgesia	Postoperative analgesia
Patient controlled analgesia (PCA)	Parecoxib 40 mg
with 1 mg morphine and droperidol	Acetaminophen 4dd 1000 mg
	Tramadol 3dd 100 mg
	Piritramide 0.2–0.3 mg/kg when indicated
Postoperative care	Postoperative care
Intensive Care Unit (ICU) or	Surgical ward
Surgical ward	
Additional concerns	Additional concerns
High labour for personnel (transfer of the patient)	Direct mobilization
Liberal intravenous fluid administration	Restricted intravenous fluid administration (max. 1L perioperative, max. 1L postoperative)
	Liberal oral fluid intake

preparation before the construction of the gastric pouch. After SG, no additional preparations were necessitated except any potential adhesiolysis.

In case of rRYGBP after AGB, the band had to be removed first and the created wrap had to be undone. This was performed in one procedure, unless there was band erosion present. In that case, the band was removed in a separate laparoscopic procedure and at least three months later, the rRYGBP was performed.

In case of an earlier VBG, procedure was started with the identification of the band. After identification, the stomach was transected horizontally at the proximal side of the band. The VBG-pouch was then resized with use of an endoscopic stapler (Endo GIA™ (Covidien, New Haven, CT, USA)), up to the angle of His.

After the creation of the pouch, an end-to-side antegastric gastrojejunostomy was constructed by a linear stapler (EndoGIA™ (Covidien, New Haven, CT, USA)) and closed using a running suture. The alimentary limb measured an estimated 150–180 cm. The limb was pulled up in an antecolic position in all procedures. The procedure was finished by constructing the jejuno-jejunostomy, again by using a linear stapler and running suture. Mostly, the procedure was finished by closing the mesenteric defect.

The alimentary limb length and the closure of the mesenteric defects were not taken into account for the current analysis.

2.3. Outcome

Patients were followed at the bariatric outpatient clinic, as part of our centre's follow-up protocol. To assess the safety of fast track care in bariatric revisional surgery, the primary outcome measurements for this study were intra- and postoperative complications less than 30 days after surgery. Included postoperative complications were bleeding, anastomotic leakage, gastro-intestinal perforation, various infectious complications (e.g. abscess, pneumonia, and wound infection), any major cardiovascular event and venous thromboembolisms. Additionally, all postoperative complications were categorized according to the Clavien–Dindo scale [14]. A multivariate analysis was performed to find potential predictors for postoperative complications after rRYGBP.

Other outcome measurements were length of hospital stay, duration of the surgical procedure and the rate of readmissions.

2.4. Statistical analysis

All data for the current study were prospectively collected and analysed retrospectively. Data management and analysis was performed using SPSS version 22 for Windows (IBM Corporation, Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation (SD). Complications and rate of readmissions are presented as a percentage.

Dependent on the distribution and type of variable, either student's *t*-test, Mann–Whitney *U*-test, Chi-square test or Fisher's exact test was used to determine any statistical significance between the observed differences among groups. Differences were considered significant in case of a p value less than 0.05.

Covariates showing a trend towards significance for developing a postoperative complication ($p < 0.1$) were considered for multivariable logistic regression analysis.

Odds ratio (OR) and 95% confidence intervals (CI) were provided when applicable and considered significant when OR (95% CI) ≠ 1.

No ethical approval was required for this study. The Institutional Review Board for this retrospective study granted permission.

3. Results

Between January 2005 and December 2013, a total of 407 patients (84% female) with a mean BMI of 37.6 ± 6.6 kg/m^2 rRYGBP were included for analysis. A total of 112 VBGs (27.5%), 174 AGBs (42.0%) and 124 SGs (30.5%) were converted to RYGBP. Mean age of the study population was 44.0 ± 8.9 years, the mean BMI before the primary bariatric procedure was 45.7 ± 7.0 kg/m^2.

A total of 104 (25.6%) patients were treated according to the CC protocol and 303 patients (74.4%) were treated according to the FT protocol. Patient characteristics of the two groups are shown in Table 2. No missing data were reported in the current study.

A total of 23 procedures employed an open approach and 384 procedures of laparoscopic approach. 11 procedures (2.8%) were converted to an open approach during surgery (CC group 6/84 vs FT group 5/300). Seven procedures were converted due to extensive adhesions of the previous procedure; three conversions were due to an intra-operative bleeding and one due to a large incisional hernia. All postoperative complications, including the

Table 2
Patient characteristics (n = 407).

	CC N = 104 (25.6%) Mean ± SD	FT N = 303 (74.4%) Mean ± SD	*p*-value
Age (years)	41.9 ± 8.9	44.7 ± 8.8	**0.007**
Male : Female (n)	15 : 89	50 : 253	0.618
Body Mass Index (BMI) (kg/m^2)	37.6 ± 6.5	37.6 ± 6.6	0.977
BMI before previous bariatric procedure (kg/m^2)	45.6 ± 7.0	45.8 ± 7.0	0.732
Preoperative comorbidities (n, %)			
Diabetes Mellitus type 2	15 (14.4%)	40 (13.2%)	0.753
Hypertension	31 (29.8%)	77 (25.4%)	0.381
Dyslipidaemia	4 (3.8%)	38 (12.5%)	**0.012**
Sleep apnoea	3 (2.9%)	22 (7.3%)	0.109
Osteo-articular disease	4 (3.8%)	30 (9.9%)	0.054
Type of previous bariatric procedure (n, %)			**<0.001**
Adjustable Gastric Banding (AGB)	23 (22.1%)	148 (48.8%)	
Sleeve Gastrectomy (SG)	26 (25.0%)	98 (32.3%)	
Vertical Banded Gastroplasty (VBG)	55 (52.9%)	57 (18.8%)	
ASA risk classification (n, %)			0.277
I	8 (7.7%)	12 (4.0%)	
II	92 (88.5%)	274 (90.4%)	
III	4 (3.8%)	17 (5.6%)	
Primary open approach (n, %)	20 (19.2%)	3 (1.0%)	**<0.001**

Table 3
Peri- and postoperative outcome (n = 407).

	CC N = 104 (25.6%) Mean ± SD	FT N = 303 (74.4%) Mean ± SD	*p*-value
Intra-operative complications (n, %)	5 (4.8%)	3 (1.0%)	**0.029**
Postoperative complications (n, %)	20 (19.2%)	34 (11.2%)	**0.038**
Surgical complications (n, %)	13 (12.5%)	19 (6.3%)	**0.042**
Anastomotic leakage	8 (7.7%)	11 (3.6%)	0.106
Bleeding	5 (4.8%)	5 (1.7%)	0.132
Gastro-intestinal perforation	1 (1.0%)	3 (1.0%)	1.000
Infectious complications (n, %)	11 (10.6%)	25 (8.3%)	0.471
Intra-abdominal abscess	7 (6.7%)	19 (6.3%)	0.868
Pneumonia	2 (1.9%)	6 (2.0%)	1.000
Urinary tract infection	1 (1.0%)	0	0.256
Wound infection	2 (1.9%)	3 (1.0%)	0.606
Cardiovascular complications (n, %)	0	0	n/a
Venous thromboembolism	0	0	n/a
Readmissions (n, %)	10 (9.6%)	24 (7.9%)	0.590
Clavien–Dindo classification (n, %)			
Clavien–Dindo I	0	0	n/a
Clavien–Dindo II	8 (7.7%)	8 (2.6%)	**0.036**
Clavien–Dindo III	10 (9.6%)	25 (8.3%)	0.668
Clavien–Dindo IV	2 (1.9%)	1 (0.3%)	0.162
Clavien–Dindo V	0	0	n/a
Serious adverse events (Clavien–Dindo ≥ 3a) (n, %)	12 (11.5%)	26 (8.6%)	0.371

stratification according to the Clavien–Dindo scale and the readmission rate are shown in Table 3. Mean operating time was 135.3 ± 42.6 minutes in the CC group vs 79.3 ± 29.3 minutes in the FT group; ($p = < 0.001$) and the mean length of hospital stay was 5.1 ± 6.3 days in the CC group vs 3.1 ± 5.3 days in the FT group; ($p \leq 0.001$).

Following the criteria as described in the Methods section, a total of 54 patients (13.3%) developed a postoperative complication < 30 days after rRYGBP, of which 22 patients (5.4%) necessitated a surgical reintervention (11 anastomotic leaks, four bleedings, four gastro-intestinal perforations and three intra-abdominal abscesses).

3.1. Multivariate analysis

A multivariate analysis was conducted on the occurrence of postoperative complications after rRYGBP. Type 2 diabetes mellitus ($p = 0.015$), operative time ($p = 0.005$), an open procedure ($p < 0.001$), conversion to open procedure ($p = 0.008$), ASA risk classification ($p = 0.055$) and conventional care protocol ($p = 0.038$) were found to be significant factors ($p < 0.1$) for developing postoperative complications after revisional RYGBP in this study after univariate analysis. Although significant between groups, age, dyslipidaemia and type of previous bariatric procedure were not found to be univariate significant predictors for the occurrence of postoperative complications ($p > 0.1$). After multivariate analysis, a primary open procedure was found to be a significant independent risk factor for postoperative complications (OR = 9.155; 95% CI [3.064–27.359]; $p = < 0.001$).

4. Discussion

Fast track anaesthesia protocols have shown to be efficient in optimizing and standardizing perioperative care and result in a reduction in hospital stay and postoperative morbidity. Our study showed a decrease in hospital stay (from 5.1 ± 6.3 days in the CC group to 3.1 ± 5.3 days in the FT group) and a decrease in postoperative complications (from 19.2% in the CC group to 11.2% in the FT group). A primary open procedure was found to be an independent predictor for postoperative complications. Also operative time significantly decreased from 135.3 ± 42.6 minutes to 79.3 ± 29.3 minutes (CC and FT group respectively).

Multiple studies have assessed the safety and efficiency of fast track care in both bariatric as well as in other abdominal procedures [11,12,15]. Be that as it may, all fast track studies in a bariatric population focused on patients undergoing a primary bariatric procedure, leaving out the more complex and difficult revisional procedures [11,12,16,17]. Therefore, this study assessed an unselected group of patients undergoing revisional RYGBP. Results may contribute to fast track implementation in revisional bariatric surgery. Potentially, current results may contribute to the consideration of a fast track protocol in other abdominal re-do procedures. The results show a significant reduction in postoperative complications < 30 days and less surgical complications since the implementation of the fast track protocol. Furthermore, less minor complications (Clavien–Dindo ≤ 2) were observed in the FT group, and both operative time and hospital stay were significant.

Few differences were found between the CC group and the FT group. Patients in the FT group were on average a few years older. Previous research has shown that patient with a higher age have an increased risk at postoperative complications [18]. Nonetheless, age turned out not to be a significant predictor after univariate analysis on postoperative complications in the current study. The type of previous bariatric procedure differed between groups, which might be explained by the time lapse. VBG used to be a commonly performed procedure but was abandoned some years ago and replaced by the newer AGB and SG [19]. The number of primary open procedures differed significantly between groups and has shown to be an independent factor in the occurrence of postoperative complications.

Noticeable is the significantly smaller number of Clavien–Dindo 1 or 2 complications. Although an ultrasound or CT-scan was not performed routinely, none of the patients suffered from a clinically obvious venous thromboembolism, which might suggest that stockings are not necessitated in these revisional procedures and low molecular weight heparins in the proper dose suffice. In current literature, there is still no consensus on the proper dose of low molecular weight heparins.

The postoperative complication rate significantly decreased from 19.2% in the CC group to 11.2% in the FT group. These rates are very comparable to previously published results on revisional RYGBP after failed VBG, AGB or SG [6,20–22]. The complication rate of the FT group is even comparable with some studies on the outcome after

primary RYGBP [23,24]. Whether the reduction in rate of complication is caused purely by this implementation is arguable, as many factors may have influenced the occurrence of postoperative complications. The choice for a primary open procedure has shown to be an independent predictive factor for the occurrence of complications in this study. Nevertheless, the total number of open procedures is still quite low, which makes it unlikely that this is the only explanation for the decrease in complications. Surgical experience should also be taken into account, as the CC group includes the first 100 revisional RYGBP procedures. Shikora et al. previously showed a large reduction in complications between the first 100 patients and the following 650 patients undergoing primary RYGBP [23]. This may be applicable in the current study as well, however, primary RYGBP has been performed for many years by experienced surgeons at this centre and the surgical technique of a revisional RYGBP is essentially similar to the one of a primary RYGBP. The use of fixed operating room teams during the day will have a contributing factor as well [25]. These fixed teams were implemented at the same time as the use of the fast track protocol in this hospital. The truth on the reduction of the postoperative complication rate is most likely found somewhere in the middle, meaning that expertise, laparoscopic approach, fixed teams and fast track care are all likely to be a contributing factor.

The reduction in percentage minor complications (Clavien–Dindo ≤ 2) may be caused by the fast track protocol, by promoting faster mobilization of patients, the decreased operating time and improved health care over the years.

The readmission rates in the CC group and the FT group were 9.6% and 7.9%, respectively. These percentages are found to be similar to previous results in studies on fast track implementation in primary RYGBP surgery [12,16]. Moreover, this study confirms the reduction in both operative time and length of hospital stay. Operative time decreased with a mean of more than 55 minutes, which can be explained by a combination of a reduced number of open procedures, increased surgical expertise and the use of fixed teams during the day. Fast track care has shown to significantly reduce the length of hospital stay [12,26]. This result can be confirmed by the current study, in which the mean hospital stay was reduced by 2 days, implying a substantial reduction in health care costs [27]. Whether this solely caused by the implementation of fast track is arguable, since primary open approach (possibly resulting in a longer postoperative recovery) and a lower rate of complications during primary admission will have an influence on the average length of hospital stay.

5. Limitations

There are some limitations to the current study design, but this study showed that revisional bariatric procedures may benefit from a centre-specific fast track protocol. First, the retrospective approach is limiting since results are dependent on the accuracy with which the medical charts were managed. Second, the design also limits the means to firmly objectify the predictive value of a learning curve in this study on revisional RYGBP. The combination of maturation of the surgical team, the high volume (currently still increasing) of revisional bariatric surgery in this centre and the increased anaesthesiological experience may bias the results of the fast track group. Drawback of the current study may be the fact that groups were not matched and that there were differences in performed operations during time. Our centre is an expert centre on revisional bariatric surgery; therefore our patient population is very diverse. This makes our patient population different from other centres. Our study did not stratify complications on their occurrence during primary admission or readmission, which might have been of clinical interest. Also our fast track anaesthesia protocol is centre-adjusted and there might be few differences with other bariatric centres in terms of the used anaesthetic agents.

Finally, our results might be biased by the course of time. As mentioned earlier, there is a combined influence of the implementation of the fast track anaesthesia protocol, the maturation of surgical experience and the use of fixed teams at the operating room. In our opinion, the effect of the surgical learning curve is very difficult to eliminate from our study results. Also the fact that the CC group and FT group differ in primary open procedures is a result of time and the emerging expert status of our centre for revisional bariatric surgery.

Despite these limitations and the fact that further research is needed to substantiate the current results, fast track care appears to be safe and efficient for patients undergoing revisional Roux-en-Y gastric bypass and may be beneficial in other abdominal revisional procedures.

6. Conclusion

Fast track care appears to be safe and efficient for patients undergoing revisional Roux-en-Y gastric bypass, but postoperative outcome may be highly dependent on surgical experience.

Ethical approval

For this type of study formal consent is not required.

Funding

None.

Conflict of interest

None.

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